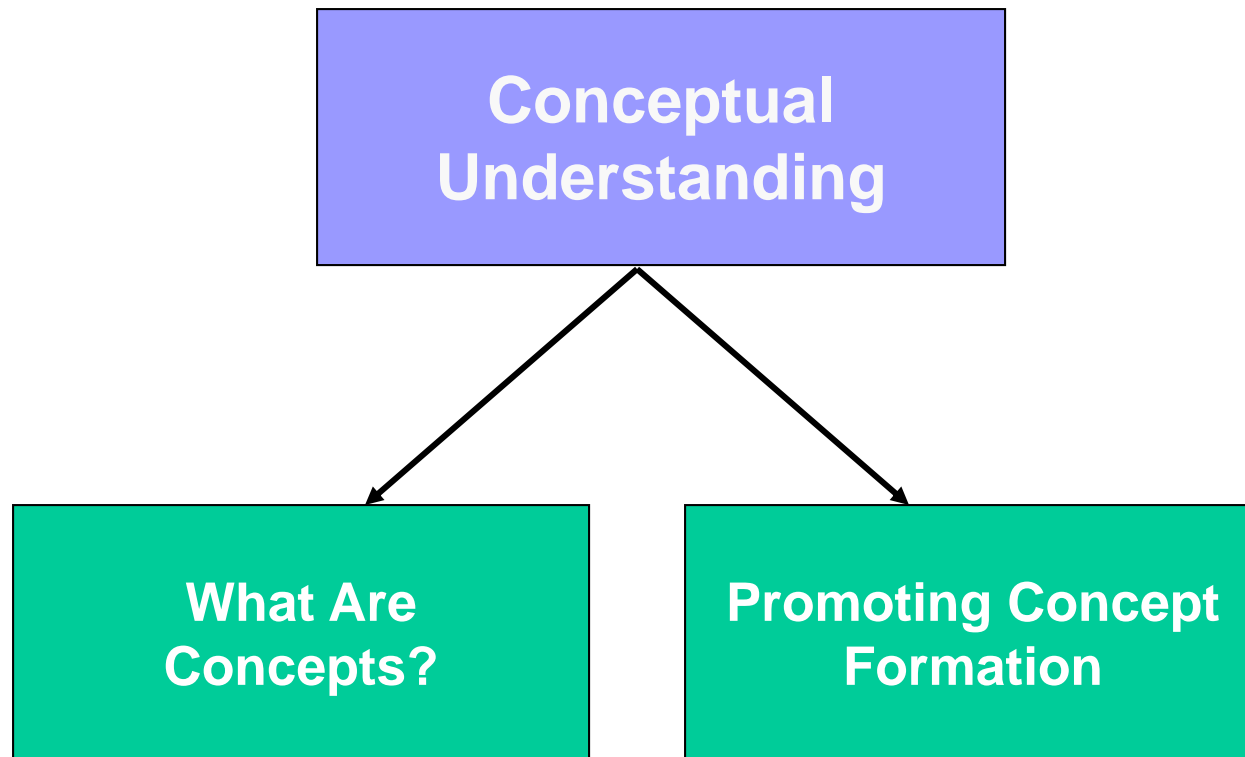


# Complex Cognitive Processes



# Conceptual Understanding

*Concepts are ideas about what categories represent, or said another way, how we group objects, events, and characteristics on the basis of common properties.*

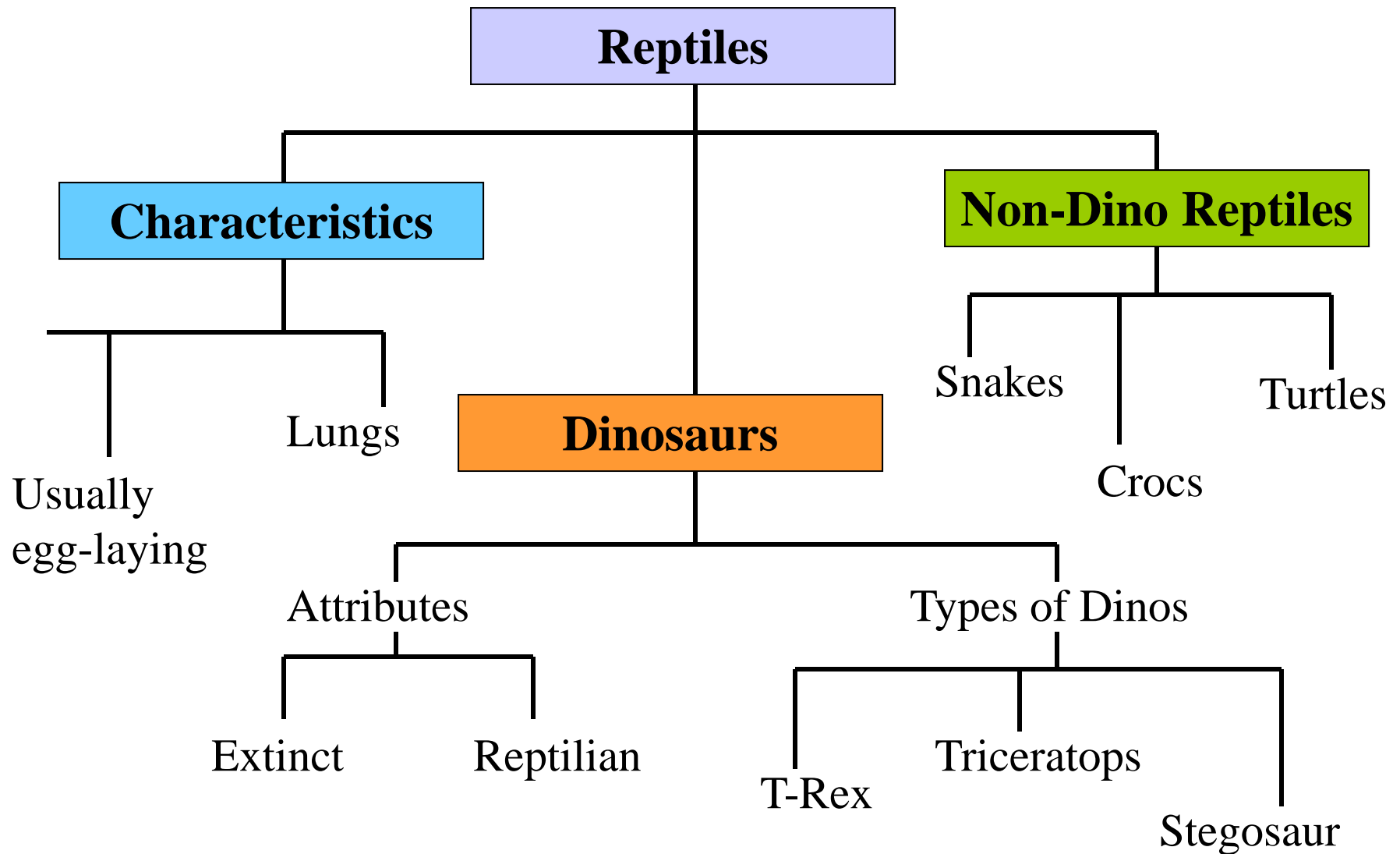
**Concepts** help us:

- simplify and summarize information
- generalize to new situations
- aid the process of remembering
- communicate more efficiently

# Teaching Concepts: *The rule-example strategy*

- *Define the concept* – identify its key features
- *Clarify terms in the definition* – make sure the key features or characteristics are understood
- *Give examples* (and non-examples as well)
- *Provide additional examples* – involve students in generating more examples and have them explain their selections

# Concept Map



# Prototype Matching

*Prototypes:* There are more typical examples of a concept

e.g., a robin flies, builds a nest in a tree, has a bird song, is a typical bird size

a penguin has none of these features

e.g., Lassie is a prototypic dog because she has qualities (like size, shape, bark) representative of dogs in general

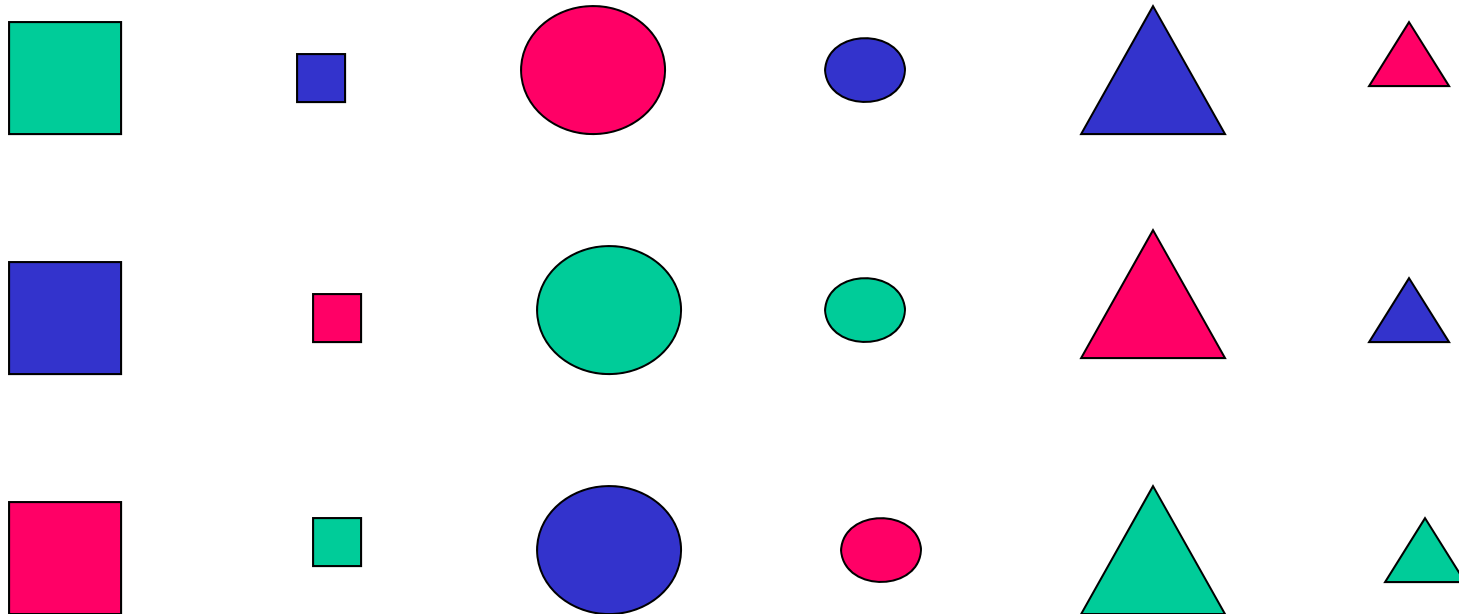
a Chihuahua does not

# Promoting Concept Formation

- Use the rule-example strategy
- Help students learn what a concept is and what it is not
- Provide clear, concrete examples
- Relate new concepts to already-known concepts
- Create concepts maps
- Generate hypotheses about concepts
- Prototype matching
- Check for understanding and generalization

# Hypothesis-Testing

*Hypotheses* are specific assumptions and predictions that can be tested



# Thinking

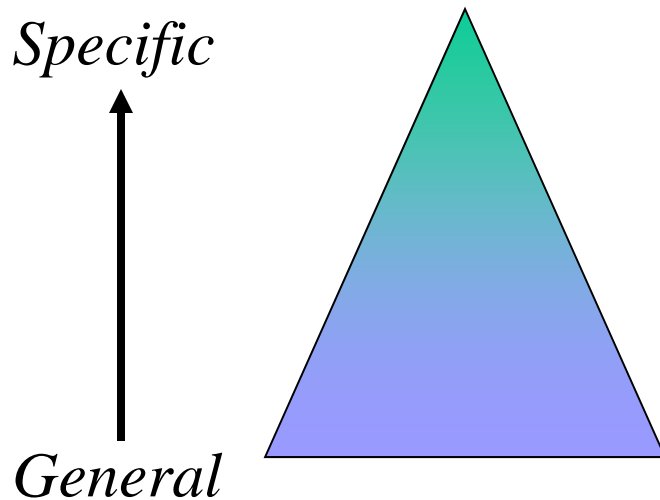
...involves manipulating and transforming information in memory

...involves

- Reasoning
- Thinking critically
- Decision making
- Thinking creatively



# Inductive Reasoning



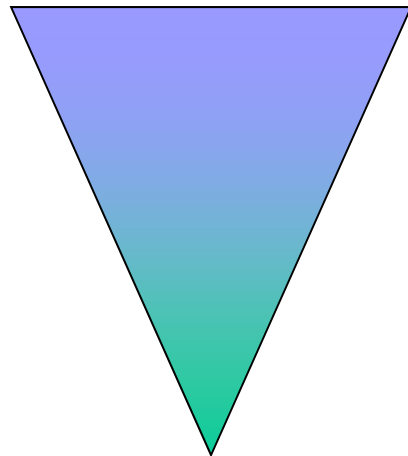
- a good predictor of academic performance
- e.g., a student reads a few Emily Dickinson poems and draws conclusions about the general nature of her poetry
- e.g., a teacher prompts several students to engage in self-explanation during math problem-solving and draws the conclusion it promotes deeper understanding

# Deductive Reasoning

*General*



*Specific*



- during adolescence students are increasingly able to reason deductively

- **Valid Conclusion?**

All things that have a motor need oil

Automobiles need oil

Therefore, automobiles have motors

War times are prosperous times, and prosperity is highly desirable; therefore, wars are much to be desired

# Critical Thinking

... is thinking reflectively and productively,  
and evaluating the evidence.

## **Mindfulness versus Mindless**

*Mindful* students are alert, open to new information, cognitively flexible, are aware of more than one perspective

*Mindless* students are entrapped in old ideas, engage in automatic behavior, accept what they read or hear without questioning, operate from one perspective

# Ways Teachers Can Encourage Critical Thinking

- Help students construct their own thinking
- Use thinking-based questions
- Provide positive role models for thinking
- Be a thinking role model for students
- Keep up-to-date on latest developments in thinking

# Cognitive Changes in Adolescence that Allow/Promote Improved Critical Thinking

- Increased speed, automaticity, and capacity of information processing
- More knowledge in a variety of domains
- Increased ability to construct new combinations of knowledge
- Greater range and more spontaneous use of strategies or procedures such as planning, considering alternatives, cognitive monitoring

# Decision Making

*Decision making involves thinking in which individuals evaluate alternatives and make choices among them.*

**Confirmation bias:** The tendency to search for information that supports our ideas rather than refutes them.

**Belief perseverance:** The tendency to hold on to a belief in the face of contradictory evidence.

# Decision Making cont'd

**Overconfidence bias:** The tendency to have more confidence in judgments and decisions than we should, based on past experience.

**Hindsight bias:** The tendency to falsely report, after the fact, that we accurately predicted the event.

# Creative Thinking

*...is the ability to think about something in novel and unusual ways and come up with unique solutions to problems.*

## **Convergent Thinking**

Produces one correct answer.

e.g.,  $4 + 7 = ?$

## **Divergent Thinking**

Produces many answers to the same question.

e.g., write a poem



# Components of Divergent Thinking

- 1) Fluency = number of solutions that fit the requirements of a problem
- 2) Flexibility (originality) = number of unusual or unique solutions. Solutions generated by few or no other people

## *Unusual Uses Test*

e.g., list as many as possible uses for a “brick.

# Steps in the Creative Process

- *Preparation:* immerse yourself in a problem
- *Incubation:* churn ideas around in your head
- *Insight:* often you'll experience an "Aha!" moment when all the pieces of the puzzle fit
- *Evaluation:* now decide whether the idea is valuable and worth pursuing
- *Elaboration:* this final step covers the longest time span of time and involves the hardest work – implementing the idea

# Ways to Improve Creativity

Encourage creative thinking on an individual and group basis

Involve creative people

Encourage internal motivation

Provide stimulating environments

Guide students to be persistent and delay gratification

# Ways to Improve Creativity *cont'd*

Guide students to help them think  
in flexible ways

Encourage  
students to take  
risks

Don't  
overcontrol  
students

Build students'  
confidence